

# The Right Stuff

An innovative technology, exceptional students, and top-notch mentors can create significant scientific advances

## High School Student and Mentor: Recognized Excellence



William works on a science project at his home.



Due in part to William's work and notable science successes, involvement of students in science at his school has quadrupled.



In 2005 Rex Gerald was named an Outstanding Mentor by the U.S. Department of Energy's Office of Science for his work with undergraduate students. Shown here is Dr. Harold Myron, Director of Argonne's Division of Educational Programs (left), presenting the award to Gerald.

William Thompson, left, and mentor Rex Gerald of Argonne's Chemical Engineering Division met at a regional science fair, where William's Helmholtz coil (shown here) caught Gerald's attention. Since that time, the two have worked together on scientifically complex tasks related to Argonne's toroid cavity imager. In 2004, both were recognized by Commonwealth Edison for their outstanding efforts--Thompson for his work with toroid cavity imagers (ComEd 100 Science Award) and Gerald for his mentoring and active support of William's work (Illuminator Award).

One of the most unusual aspects of William's involvement has been the computer system he set up at home. He was able to acquire an old Sun Microsystems computer workstation and an NMR software license and manuals donated by Varian. This enabled him to access sophisticated, expensive research equipment off-line in order to analyze his work. With unlimited access and no concerns about what could accidentally happen to equipment, William was quickly far ahead of where he would otherwise have been.

## Argonne's Toroid Cavity Imager

*Sophisticated and versatile*



Scientists in Argonne's Chemical Engineering Division have invented a device--a toroid cavity imager--that uses nuclear magnetic resonance (NMR) technology to reveal the location and characteristics of materials inside sealed metal containers. Moisture, degradation products, and other chemical reaction products can be detected and measured nondestructively. The device's high resolution and sensitivity make it attractive for a wide array of uses.

This sophisticated, versatile technology affords abundant and varied opportunities for invention. In the hands of the Chemical Engineering Division's Physical Organometallic Chemistry group, headed by Jerome (Jerry) Rathke, it has generated an impressive portfolio of inventions and provided a rich opportunity for students to conduct research that culminates in significant scientific advances.

Argonne's research on the toroid cavity imager is funded by the U.S. Department of Energy's Office of Science, Basic Energy Sciences, Division of Chemical Sciences.



### Uses for Toroid Cavity Imager

*Inspects contents of sealed packages without opening or damaging the package or its contents*

- Manufacturing control and product storage lifetimes
- Safety/security
- Inspecting packages
- Detecting explosives or hazardous/toxic chemicals
- Research
- Detecting and measuring the products of chemical reactions within sealed environment
- Study of battery and fuel cell chemistry
- Materials research (ceramics, alloys, composites, coatings)
- Environment
- Nuclear waste monitoring

### Features/Advantages

- Simple to manufacture, easy to use, and robust
- High sensitivity
- Good ability to resolve/identify different chemical liquids and solutions
- Good ability to specify location of liquid chemicals
- Nondestructive

## No "Cookie-Cutter" Projects

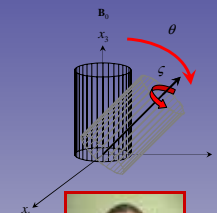
Among Rex Gerald's criteria for his students:

- Present a paper at an international conference
- Write a peer-reviewed manuscript
- Produce an invention report and patent application

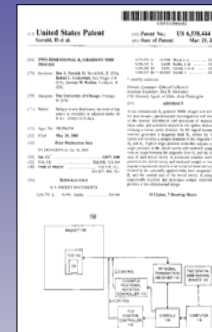
Two of Gerald's former students (Rafael Greenblatt and Jairo Sanchez) have patents on their work, and patents are pending for many additional students.



42<sup>nd</sup> Rocky Mountain Conference on Analytical Chemistry  
August 1, 2000  
(Presentation at International Conference)



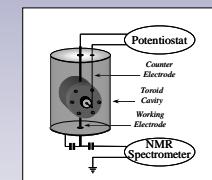
Rafael Greenblatt  
University of California Berkeley



Jairo Sanchez  
University of Illinois at Chicago



43<sup>rd</sup> Rocky Mountain Conference on Analytical Chemistry  
July 29 - August 2, 2001  
(Presentation at International Conference)



Peer-Reviewed Journal Article

